THURBER ENGINEERING LTD.

FOUNDATION INVESTIGATION AND DESIGN REPORT
OVERHEAD SIGN REPLACEMENT
NICHOLAS STREET ON-RAMP TO HIGHWAY 417
OTTAWA, ONTARIO

GWP 4048-11-00
WP 4253-15-01

Geocres No.: 31G5-290

Report to:

WSP Canada

Latitude: 45.4182
Longitude: -75.6772

March 2018
Thurber File: 18006

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PART 1. FACTUAL INFORMATION

1 INTRODUCTION

This section of the report presents the factual findings obtained from a foundation investigation completed for the proposed overhead sign replacement on the Nicholas Street on-ramp to Highway 417 within the City of Ottawa. Thurber Engineering Limited (Thurber) carried out the current investigation as a sub-consultant to WSP Canada (WSP) under 4015-E-0013, Assignment 18.

The purpose of this investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, laboratory test results and a written description of the subsurface conditions.

2 SITE DESCRIPTION

An existing overhead sign is present over the southbound lanes of the Nicholas Street on-ramp to Highway 417. The sign is located about 320 metres north of the existing Highway 417 overpass structure and about 90 metres south of the Mann Avenue overpass structure. The sign spans three lanes of traffic with the eastern footing located on the concrete median of Nicholas Street and the western footing located on the embankment just outside the roadway on the west side of the existing guardrail. It is understood that the new overhead sign will be located about 5.9 m north of the existing sign and will have similar dimensions, but with the western footing located further from the guardrail (about 3.6 m) than existing.

The existing ground surface elevation of Nicholas Street at the sign location is about 67 m. The embankment slope on the west side of Nicholas Street is vegetated with grass and has a slope inclination of about 15H:1V.

Select photographs showing the area of the new sign are included in Appendix D for reference.

A review of previous borehole records in the vicinity of this site indicate that the subsurface conditions in this area consist of fill overlying a cohesive deposit of native silty clay to clayey silt, over a non-cohesive silt to sand, over glacial till. Published geological mapping indicates that the depth to bedrock is in the range of 10 to 15 metres below the pre-development

ground surface. The bedrock surface was confirmed at previous boreholes at the nearby Nicholas Street overpass at elevations ranging from of 49 m to 55 m (see Geocres references below), which is about 12 to 18 m below the existing ground surface at the overhead sign location. The published geological mapping indicates that the bedrock consists of shale of the Carlsbad Formation.

The following foundation investigation reports were obtained from the online Geocres library and reviewed in preparation of this report:

- Preliminary Site Investigation, Proposed Queensway – Nicholas Street Interchange, Bridges 38, 39, 40 and 41, Ottawa, Ontario, dated December 1963. [Geocres 31G05-056].
- Site Investigation, Proposed Canal Road Bridge No. 38, Stage IV Interchange, Ottawa Queensway, W.P. 954-59, Ottawa, Ontario, dated March 1964. [Geocres 31G05-062].

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing program was carried out on October 26th and 27th, 2017. The field investigation consisted of advancing two boreholes identified as 17-01 and 17-02. The drilling was carried out using a track mounted CME 550 drill rig (Borehole 17-01) and a truck mounted CME 55 drill rig (Borehole 17-02). Prior to the commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations.

Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). In-situ vane shear testing was completed in the cohesive soil deposits. Boreholes 17-01 and 17-02 were drilled and sampled to depths of 9.8 and 10.4 m below the existing ground surface, respectively (elev. 56.3 and 56.7 m, respectively).

The drilling and sampling operations were supervised on a full-time basis by a member of Thurber's geotechnical staff. The drilling supervisor logged the boreholes and processed the recovered soil samples for transport for further laboratory examination and testing.

A vibrating wire piezometer was installed in Borehole 17-01 with its sensor tip at a depth below ground surface of 8.4 m (elev. 57.7 m) to allow for measurements of the groundwater level after completion of drilling. The vibrating wire piezometer was installed within sand and sealed with bentonite. Following completion of the field investigation, the vibrating wire piezometer will be decommissioned. The boreholes were backfilled in general accordance with MOEE requirements (O.Reg. 903).

The approximate borehole locations are shown on the Borehole Location drawing included in Appendix A. The coordinates and elevation of the boreholes are provided on this drawing and on the individual Record of Borehole sheets.

4 LABORATORY TESTING

Geotechnical laboratory testing consisted of visual identification and natural moisture content determination on all the recovered soil samples. Grain size distribution and Atterberg Limit testing were also carried out on selected soil samples. One sample of soil

recovered from Borehole 17-02 was selected and submitted for analytical testing of corrosivity parameters and sulphate content.

The results of the geotechnical laboratory testing are summarized on the Record of Borehole sheets included in Appendix B and all laboratory test results are provided in Appendix C.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 General

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix B and the Borehole Location drawing included in Appendix A. A general description of the stratigraphy based on the conditions encountered in the boreholes from the current investigation is given in the following sections. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. It must be recognized that the soil and groundwater conditions may vary between and beyond borehole locations.

In general terms, the subsurface conditions at the borehole locations consist of surficial pavement structure overlying heterogeneous embankment fill, the lower portions of which contain waste debris (e.g., coal, brick, ash). The off-road borehole encountered topsoil above the fill. The fill is underlain by a native deposit of sensitive marine clay.

5.2 Fill

5.2.1 Surficial Pavement Structure

Borehole 17-02 was drilled through the pavement structure of Nicholas Street in the easternmost southbound lane. The pavement structure consisted of 200 mm of asphaltic concrete over granular fill consisting of gravel with sand. The granular fill was 1.0 m thick with a base elevation of 65.9 m.

Two SPT tests conducted in the granular fill gave N-values of 34 and 47 blows, indicating a dense state of packing.

The recorded moisture contents of the two granular fill samples were 2 and 14%.

5.2.2 Surficial Silty Sand (Topsoil)

Borehole 17-01 was drilled on the west side of the Nicholas Street embankment and encountered topsoil at the surface. The topsoil consisted of silty sand with organics and had a thickness of 500 mm.

An SPT test conducted in the topsoil gave an N-value of 5 blows per 0.3 m of penetration, indicating a loose state of packing.

The recorded moisture content of the topsoil sample was 29%.

5.2.3 Heterogeneous Fill

Heterogeneous embankment fill was present below the pavement structure or topsoil at both of the borehole locations. The composition of the fill is highly variable and ranges from sand, to silty sand, to clay, and contains variable amounts of gravel and waste debris (e.g.,

coal, brick, ash). Borehole 17-01 encountered a 0.9 m thick layer of waste at a depth of 2.9 m. Cobbles and/or boulders could also be present within the fill based on the resistance to augering encountered during drilling. The heterogeneous embankment fill was 4.7 and 7.6 m thick at Boreholes 17-01 and 17-02, respectively, with base elevations of 60.9 and 58.2 m, respectively.

The SPT tests conducted in the heterogeneous fill gave N-values ranging from 2 to 33 blows, indicating a very loose to dense state of packing.

The recorded moisture contents of the heterogeneous fill samples that contained primarily cohesionless soil ranged from 4 to 16%. The recorded moisture contents of the two samples that contained primarily clay were 32 and 33 percent.

The results of grain size distribution testing conducted on five samples of the heterogeneous fill are summarized below and are illustrated on Figure C1 in Appendix C.

Soil Particle	Percentage (%)	
	Primarily Sand Samples	Primarily Clay Sample
Gravel	3 – 39	0
Sand	52 – 90	10
Silt	7 – 40	29
Clay		61

Atterberg Limit testing was completed on two samples of the heterogeneous fill (one sample of primarily clay and one sample of primarily silty sand that also contained waste and pockets of silty clay). The results are summarized on the Record of Borehole sheets in Appendix B and on Figure C3 in Appendix C. The results of the Atterberg limit testing indicated that the clay fill sample had a Liquid Limit of 59%, a Plasticity Limit of 25% and a Plasticity Index of 34%, which indicate that the clay fill has high plasticity. The results also indicated that the silty sand fill sample was non-plastic.

5.3 Marine Clay

A native deposit of sensitive marine clay was present below the heterogeneous fill.

At Borehole 17-01, the marine clay contains trace sand and is grey in colour. The clay in Borehole 17-01 was not fully penetrated, but was proven to extend to a minimum depth of 9.8 m depth (elevation 56.3 m). SPT tests conducted in the grey clay gave N-values of 2 to 7 blows. Field vane tests were performed within the deposit and recorded undrained shear strengths ranging from 42 to greater than 106 kPa, indicating a firm to very stiff consistency. Remoulded field vane testing in the grey clay indicates sensitivity. The recorded moisture contents of the grey clay samples ranged from 44 to 61%.

At Borehole 17-02, the marine clay is grey brown in colour and contains sand seams and natural wood fragments below elev. 54.4 m. The clay in borehole 17-02 was not fully penetrated, but was proven to extend to a minimum depth of 10.4 m (elevation 56.7 m). Two SPT tests conducted in the grey brown clay gave N-values of 1 and 7 blows, indicating

a firm to very stiff consistency based on similar results observed in Borehole 17-01. The recorded moisture contents of the grey brown clay samples ranged from 24 to 36%.

The results of grain size distribution testing conducted on three samples of the marine clay are summarized below and are illustrated on Figure C2 in Appendix C.

Soil Particle	Percentage (%)
Gravel	0 – 1
Sand	2 – 32
Silt	28 – 36
Clay	35 – 70

Atterberg Limit testing was completed on three samples of the marine clay. The results are summarized on the Record of Borehole sheets in Appendix B and on Figure C4 in Appendix C. The laboratory results are summarized below and indicate that the clay is of low to high plasticity (CL/CI/CH).

Parameter	Value
Liquid Limit	32 – 62
Plastic Limit	15 – 25
Plasticity Index	17 – 37

5.4 Groundwater

At the completion of drilling, a vibrating wire piezometer was installed in Borehole 17-01 with its sensor tip at a depth of 8.4 m (elev. 57.7 m) to allow for measurements of the groundwater level. The groundwater level was measured at an approximate depth of 2.6 m (elev. 63.5 m) on November 27th, 2017.

These observations are considered short term and it should be noted that the groundwater level at the time of construction may be higher and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation during the spring and/or after periods of significant and/or prolonged precipitation.

5.5 Analytical Testing

One sample of soil was submitted to Paracel Laboratories in Ottawa, Ontario for analysis of water soluble sulphate and chloride concentrations, pH, and resistivity. The analysis results are included in Appendix C and are summarized in the table below:

Borehole	Sample	Depth (m)	Sulphate (μg/g)	pH	Resistivity (Ohm-m)	Chloride (μg/g)
17-02	SS3	1.5 – 2.1	1,700	7.86	3.90	763

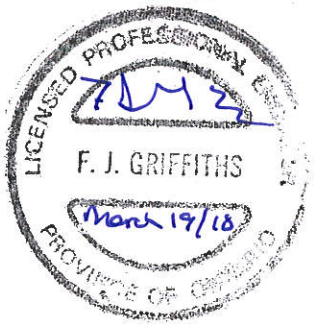
6 MISCELLANEOUS

Borehole locations were selected by Thurber relative to existing site features and the anticipated foundation locations. The as-drilled locations and ground surface elevation were measured by Thurber following completion of the field program relative to a temporary benchmark provided by WSP.

George Downing Estate Drilling Ltd. of Hawksbury, Ontario supplied and operated the drilling equipment to conduct the drilling, soil sampling, in-situ testing, vibrating wire piezometer installation and borehole decommissioning of the boreholes. Beacon Lite Ltd. of Ottawa, Ontario supplied, erected, and dismantled the traffic protection required during the drilling. The field investigation was supervised on a full-time basis by Ms. Katya Edney, P.Eng. of Thurber. Overall supervision of the investigation program was provided by Mr. Stephen Peters, P.Eng.

Geotechnical laboratory testing was completed by Thurber's laboratory in Ottawa, Ontario. Analytical testing was completed by Paracel Laboratories in Ottawa, Ontario. Interpretation of the factual data and preparation of this report were carried out by Mr. Stephen Dunlop, P.Eng. The report was reviewed by Dr. Fred Griffiths, P.Eng., a Designated Principal Contact for MTO Foundation Projects.

Stephen Dunlop, P.Eng.
Senior Geotechnical Engineer



Dr. Fred Griffiths, P.Eng.
Senior Associate
Senior Geotechnical Engineer

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PART 2. ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 GENERAL

This section of the report presents interpretation of the factual data in Part 1 of this report for the proposed overhead sign replacement on the Nicholas Street on-ramp to Highway 417 within the City of Ottawa. Geotechnical assessment and recommendations are provided to assist the design team in designing a suitable foundation for the proposed overhead sign.

Information on the general location of the proposed sign was provided to Thurber by WSP. It is anticipated that the sign will be designed as a tri-chord static sign with two supports. Based on the design layout, one borehole was drilled near each of the sign support locations to provide subsurface information for detailed foundation design of the sign supports. The Records of Boreholes are presented in Appendix B.

This foundation investigation and design report with the interpretation and recommendations contained herein are intended for the use of the Ministry of Transportation, and shall not be used or relied upon for any other purposes or by any other parties including the construction or design-build contractor. The construction or design-build contractor must make their own interpretation based on the factual data in Part 1 of the report. Where comments are made on construction, they are provided only in order to highlight those aspects which could affect the design of the project. Contractors must make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

7.1 Foundation Design Parameters

Design of the sign support foundations should be carried out in accordance with the following document:

- Ministry of Transportation, Ontario (2015) “Sign Support Manual”, Provincial Highways Management Division, Highway Standards Branch, Bridge Office (Reference 1).

Reference should also be made to the following document:

- Canadian Highway Bridge Design Code (2014) CSA S6-14 (Reference 2).

The sign supports should be designed in accordance with the MTO Sign Support Manual for a Tri-Chord Static Sign (Section 4). At this site, the foundation soil generally consists of compact silty sand with gravel fill, clay fill with waste materials, and native firm to very stiff clay. Section 4.1.4 of the Sign and Support Manual indicates that where landfill material is encountered the footings should be designed by an engineer. Soil parameters for use in design are provided in Table E1 in Appendix E. It is noted that the recommended geotechnical design parameters provided in Table E1 are equal to or better than the minimum soil parameters outlined in Section 4.5.4 of the Sign Support Manual, which are applicable to the standard design shown in standard drawing SS118-3 (copy provided in Appendix E). As such, the standard design can be used for the proposed overhead sign. The standard design includes a 1,200 mm diameter concrete caisson with a minimum footing depth extending to 5 m below the frost depth, which is 1.8 m per OPSD 3090.101.

It should be noted that the boreholes were drilled as close as feasible to the proposed footing locations; however, some variation should be anticipated in soil conditions between locations.

Borehole 17-01 was drilled mid-slope through the existing embankment slope. It is anticipated that the western footing may be supported on non-level (sloping) ground. The geotechnical design parameters to be used for design will need to take into consideration the vertical offset between the ground surface at the borehole location and the ground surface at the footing location.

7.2 Caisson Installation

Caisson installation should generally be carried out in accordance with OPSS 915 (sign support structures) and OPSS 903 (deep foundations). The contract documents should contain an NSSP alerting the contract bidders of the specific aspects relating to caisson construction for the sign support foundations at this site. Suggested wordings for this NSSP are provided in Appendix E.

Caisson installation equipment must be able to dislodge, handle and remove obstructions, cobbles and boulders within the fill. Based on the subsurface conditions encountered during the investigation, the drilled holes for the caissons are expected to remain open during construction even if they are unsupported; however, unexpected soil sloughing or water seepage could occur. As such, temporary liners should be available to support the caisson sidewalls and provide seepage cut-off, as required.

7.3 Construction Concerns

Concerns during caisson construction mainly involve the handling and removal of cobbles or boulders, and seepage into the foundation excavation. Recommendations on how to address these issues have been outlined in the previous section. There is a potential to encounter waste within the depth of excavation. The contractor should be prepared to handle and appropriately dispose of the waste off-site.

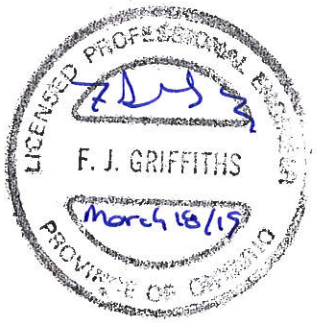
7.4 Construction Inspection and Testing

Caisson construction should be monitored by qualified geotechnical personnel as per OPSS 903 to verify the soil conditions and to confirm that those conditions are consistent with the design assumptions in this report.

8 CLOSURE

Engineering analysis and preparation of this report was completed by Stephen Dunlop, P.Eng. The report was reviewed by Dr. Fred Griffiths, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Stephen Dunlop, P.Eng.
Senior Geotechnical Engineer



Dr. Fred Griffiths, P.Eng.
Senior Associate
Senior Geotechnical Engineer

Appendix A.

Borehole Location Plan

MINISTRY OF TRANSPORTATION, ONTARIO

N 5 031 400

N 5 031 300

N 5 031 200

N 5 031 100

N 5 031 000

E 368 900

E 369 000

E 369 100

E 369 200

E 369 300

E 369 400

E 369 500

17-02

17-01

LEES AVE.

TRANSITWAY

NICHOLAS ST.

HWY 417 WBL

HWY 417 EBL

PLAN

40 0 40 80m

SCALE 1:2000

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No

GWP No 4048-11-00

HIGHWAY 417
NICHOLAS STREET
OVERHEAD SIGN
BOREHOLE LOCATION PLAN

SHEET

wsp

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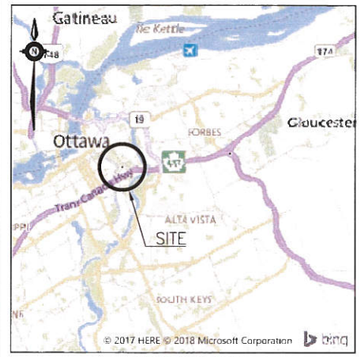

KEYPLAN

LEGEND

Borehole

NO	ELEVATION	NORTHING	EASTING
17-01	66.1	5 031 234.5	369 191.2
17-02	67.1	5 031 251.4	369 198.2

-NOTES-

GEOCRES No. 31G5-290

LICENSED PROFESSIONAL ENGINEER
Mar. 19/18
S. W. DUNLOP
100151238
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
F. J. GRIFFITHS
March 19/18
PROVINCE OF ONTARIO

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN DJP	CHK –	CODE	LOAD	DATE MAR 2018	
DRAWN MFA	CHK SD	SITE	STRUCT	DWG 1	

FILENAME: H:\Drafting\18000\18065\TED-18065-BHPL.dwg
PLOTDATE: 3/9/2018 9:32 AM

Appendix B.

Record of Borehole Sheets

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SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

Topsoil	mixture of soil and humus capable of supporting vegetative growth
Peat	mixture of fragments of decayed organic matter
Till	unstratified glacial deposit which may include particles ranging in sizes from clay to boulder
Fill	material below the surface identified as placed by humans (excluding buried services)

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

Desiccated	having visible signs of weathering by oxidization of clay materials, shrinkage cracks, etc.
Fissured	having cracks, and hence a blocky structure
Varved	composed of alternating layers of silt and clay
Stratified	composed of alternating successions of different soil types, e.g. silt and sand
Layer	> 75 mm in thickness
Seam	2 mm to 75 mm in thickness
Parting	< 2 mm in thickness

RECOVERY:

For soil samples, the recovery is recorded as the length of the soil sample recovered.

N-VALUE:

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 63.5 kg hammer falling 0.76 m, required to drive a 50 mm O.D. split spoon sampler 0.3 m into undisturbed soil. For samples where insufficient penetration was achieved and N-value cannot be presented, the number of blows are reported over the sampler penetration in millimetres (e.g. 50/75).

DYNAMIC CONE PENETRATION TEST (DCPT):

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to an “A” size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone 0.3 m into the soil. The DCPT is used as a probe to assess soil variability.

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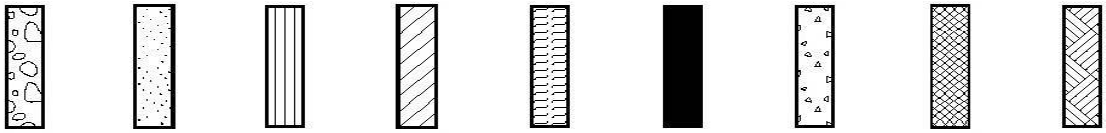
STRATA PLOT:
Strata plots symbolize the soil and bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders
Cobbles
Gravel
Sand
Silt
Clay
Organics
Asphalt
Concrete
Fill
Bedrock

TEXTURING CLASSIFICATION OF SOILS

Classification	Particle Size
Boulders	Greater than 200 mm
Cobbles	75 – 200 mm
Gravel	4.75 – 75 mm
Sand	0.075 – 4.75 mm
Silt	0.002 – 0.075 mm
Clay	Less than 0.002 mm

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

Descriptive Term	Undrained Shear Strength (kPa)
Very Soft	12 or less
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

NOTE: Clay sensitivity is defined as the ratio of the undisturbed strength over the remolded strength.

SAMPLE TYPES

SS	Split spoon samples
ST	Shelby tube or thin wall tube
DP	Direct push sample
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ etc.	Rock core sample obtained with the use of standard size diamond coring equipment

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

Descriptive Term	SPT "N" Value
Very Loose	Less than 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	Greater than 50

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MODIFIED UNIFIED SOIL CLASSIFICATION

Major Divisions		Group Symbol	Typical Description
COARSE GRAINED SOIL	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILT AND CLAY SOILS $W_L < 35\%$	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS $35\% < W_L < 50\%$	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other organic soils.

Note - W_L= Liquid Limit

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EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock materials.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structures are preserved.

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1 m in length or larger, as a percentage of total core length
Unconfined Compressive Strength: (UCS)	Axial stress required to break the specimen.
Fracture Index: (FI)	Frequency of natural fractures per 0.3 m of core run.

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 to 2 m
Medium bedded	0.2 to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 to 60 mm
Laminated	6 to 20 mm
Thinly laminated	Less than 6 mm

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)
Extremely Strong	Greater than 250
Very Strong	100 – 250
Strong	50 – 100
Medium Strong	25 – 50
Weak	5 – 25
Very Weak	1 – 5
Extremely Weak	0.25 – 1

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-01 1 OF 2 METRIC

GWP# 4048-11-00 LOCATION Nicholas Street Overhead Signs - MTM z9: N 5 031 234.5 E 369 191.2 ORIGINATED BY KE

HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DJP

DATUM Geodetic DATE 2017.10.26 - 2017.10.26 CHECKED BY SD

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (UNCONFINED, FIELD VANE, QUICK TRIAXIAL, LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
66.1											
0.0 / 65.6	SILTY SAND, trace organics **TOPSOIL** Loose Brown		1	SS	5		66				
0.5 / 64.2	SILTY SAND with gravel Very loose to dense Grey-brown **FILL** - auger resistance (grinding) on possible cobbles/boulders between 0.5 m and 0.9 m depth		2	SS	33		65				16 66 18 (SI+CL)
			3	SS	2						
1.9 / 64.0	CLAY, trace gravel Grey						64				
2.1 / 63.2	**FILL** SILTY SAND with gravel Compact Grey-brown **FILL**		4	SS	15						
2.9 / 62.3	WASTE: coal, brick and ash mixed with SILTY SAND, trace gravel Compact Black **FILL**		5	SS	18		63				
3.8 / 61.5	CLAY with sand pockets, trace gravel and WASTE: brick, ash Grey-brown **FILL**		6	SS	4		62				0 10 29 61
4.6 / 60.9	SAND Loose Brown **FILL**		7	SS	5		61				
5.2	**CLAY (CH)**, trace sand Firm to very stiff Grey		8	SS	2						
			9	SS	2		60				
							59	>>			vane attempts maxed out at 106 kPa
								>>			
			10	SS	2		58				0 2 28 70
	- becoming firm at 8.5 m							10.5 +			
								>>			vane attempt maxed out at 106 kPa
			11	SS	7		57				
56.3											
9.8	End of Borehole										

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 18006_HWY417SIGNS - NICHOLAS.GPJ 2012TEMPLATE(MTO).GDT 12/3/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-01 2 OF 2 METRIC

GWP# 4048-11-00 LOCATION Nicholas Street Overhead Signs - MTM z9: N 5 031 234.5 E 369 191.2 ORIGINATED BY KE

HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DJP

DATUM Geodetic DATE 2017.10.26 - 2017.10.26 CHECKED BY SD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Vibrating Wire Piezometer (VWP) installed at 8.4 m. Groundwater level measured in VWP at 2.6 m BGS (Elev. 63.5 m) on 2017/11/27										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 18006_HWY417SIGNS - NICHOLAS.GPJ 2012TEMPLATE(MTO).GDT 12/3/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-02 1 OF 2 METRIC

GWP# 4048-11-00 LOCATION Nicholas Street Overhead Signs - MTM z9: N 5 031 251.4 E 369 198.2 ORIGINATED BY KE

HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DJP

DATUM Geodetic DATE 2017.10.27 - 2017.10.27 CHECKED BY SD

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
67.1											
0.0	**200 mm ASPHALT**						67				
0.2	GRAVEL with sand Dense Grey **FILL**		1	SS	47						
65.9			2	SS	34		66				
1.2	SAND, trace gravel										
65.6	Dense										
1.5	Brown **FILL**		3	SS	22		65				
	SAND with gravel, trace WASTE: bricks, coal, occasional silty clay pockets Compact to dense Grey-brown **FILL**		4	SS	15						39 53 8 (SI+CL)
63.3			5	SS	30		64				
3.8	SILTY SAND, trace to some gravel, occasional silty clay pockets Compact Grey-bown **FILL**		6	SS	15						
			7	SS	15		63				
	- trace WASTE: coal, bricks at 5.3 m - frequent sand pockets below 5.3 m		8	SS	18						8 52 25 15 non-plastic
60.0			9	SS	13		62				
7.1	SAND, trace gravel Very loose to loose Brown **FILL**		10	SS	2						
			11	SS	5		61				3 90 7 (SI+CL)
58.2			12	SS	3						
8.9	**CLAY (CL to CI)** with frequent sand seams / interbeds, trace gravel Firm to very stiff Grey-brown		13	SS	1		60				1 32 28 39
	- wood fragments below 12.7 m		14	SS	7		59				
							58				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-02 2 OF 2 METRIC

GWP# 4048-11-00 LOCATION Nicholas Street Overhead Signs - MTM z9: N 5 031 251.4 E 369 198.2 ORIGINATED BY KE

HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DJP

DATUM Geodetic DATE 2017.10.27 - 2017.10.27 CHECKED BY SD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
56.7			14	SS	7		57				0 29 36 35
10.4	End of Borehole at 10.4 m										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

ONTMT4S 18006_HWY417SIGNS - NICHOLAS.GPJ 2012TEMPLATE(MTO).GDT 12/3/18

Appendix C.

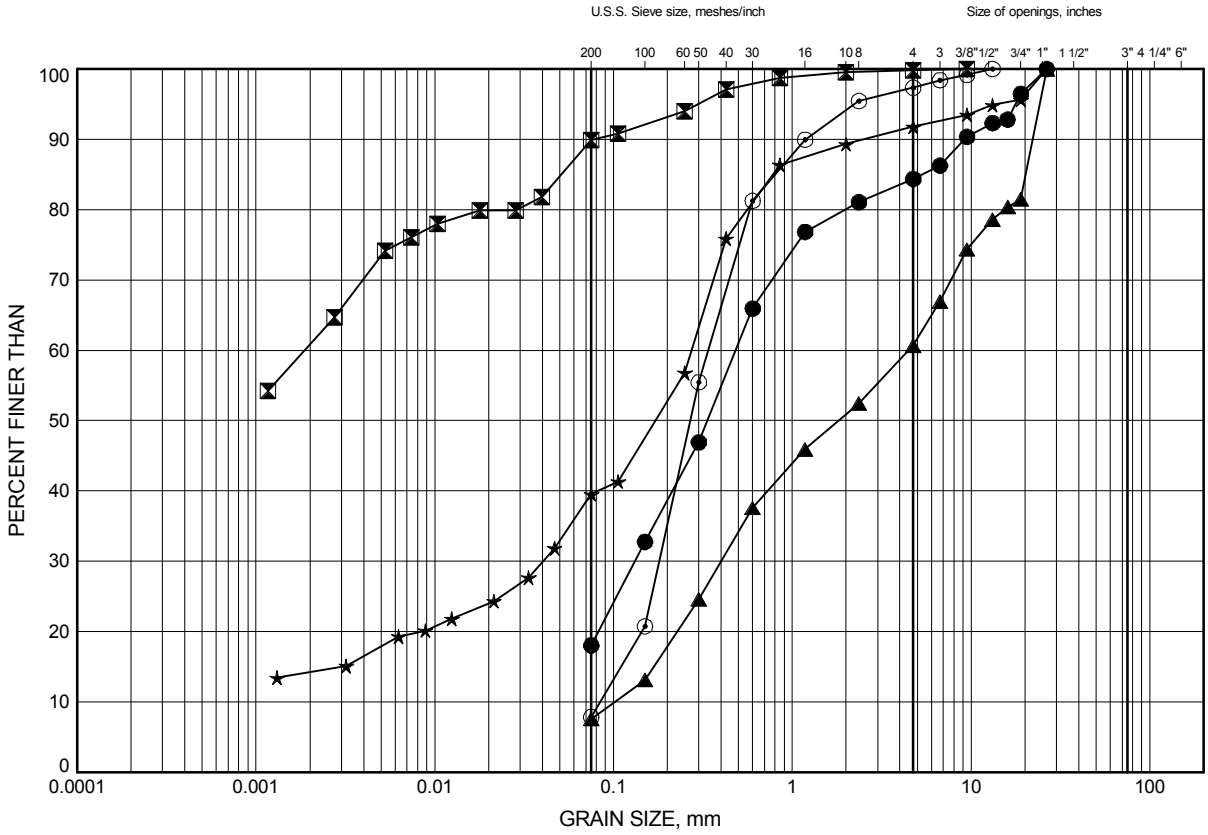
Laboratory Testing

Nicholas Overhead Signs

GRAIN SIZE DISTRIBUTION

FIGURE C1

FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-01	1.07	65.03
⊠	17-01	4.11	61.98
▲	17-02	2.59	64.51
★	17-02	5.64	61.46
⊙	17-02	7.92	59.17

Date January 2018

GWP# 4048-11-00

THURBER

Prep'd DJP

Chkd. SD

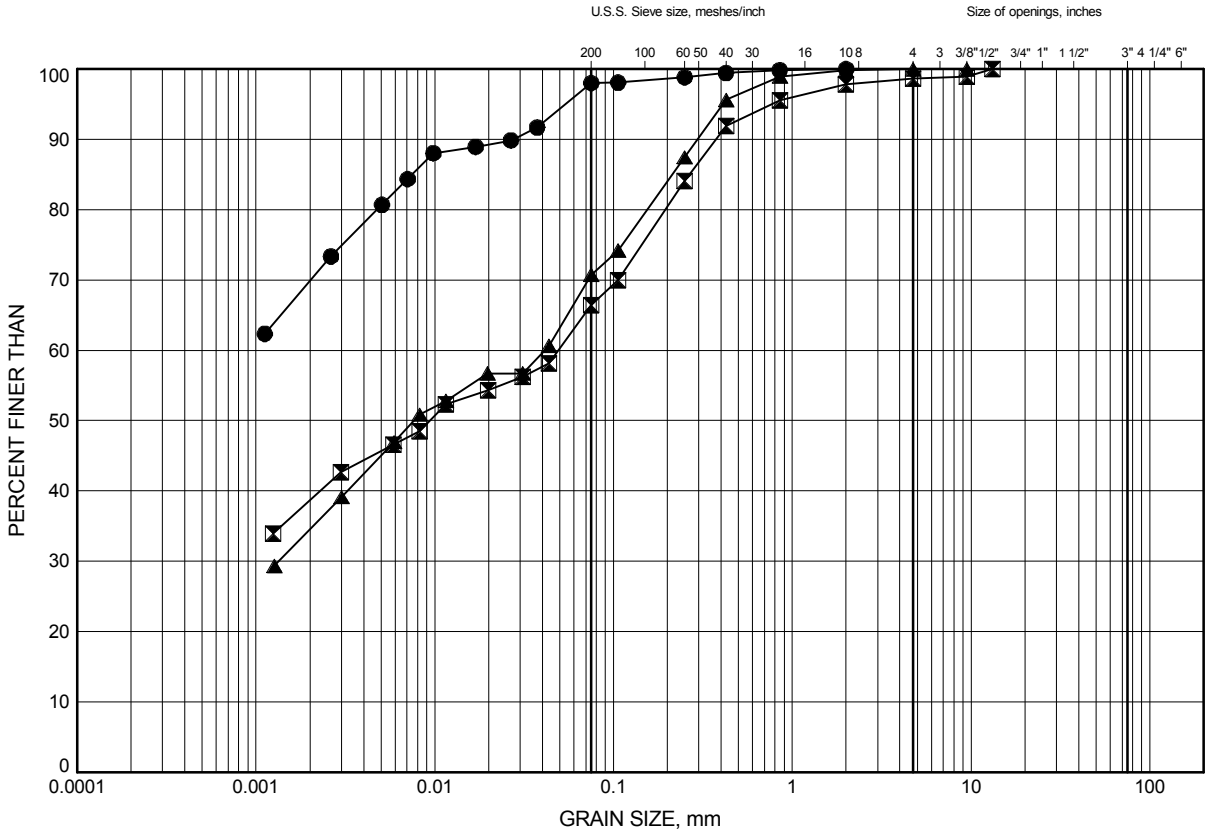
GRAIN SIZE DISTRIBUTION - THURBER 18006_HWY417SIGNS - NICHOLAS.GPJ 8/1/18

Nicholas Overhead Signs

GRAIN SIZE DISTRIBUTION

FIGURE C2

CLAY



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-01	7.92	58.17
⊠	17-02	9.45	57.65
▲	17-02	10.21	56.89

Date January 2018

GWP# 4048-11-00

THURBER

Prep'd DJP

Chkd. SD

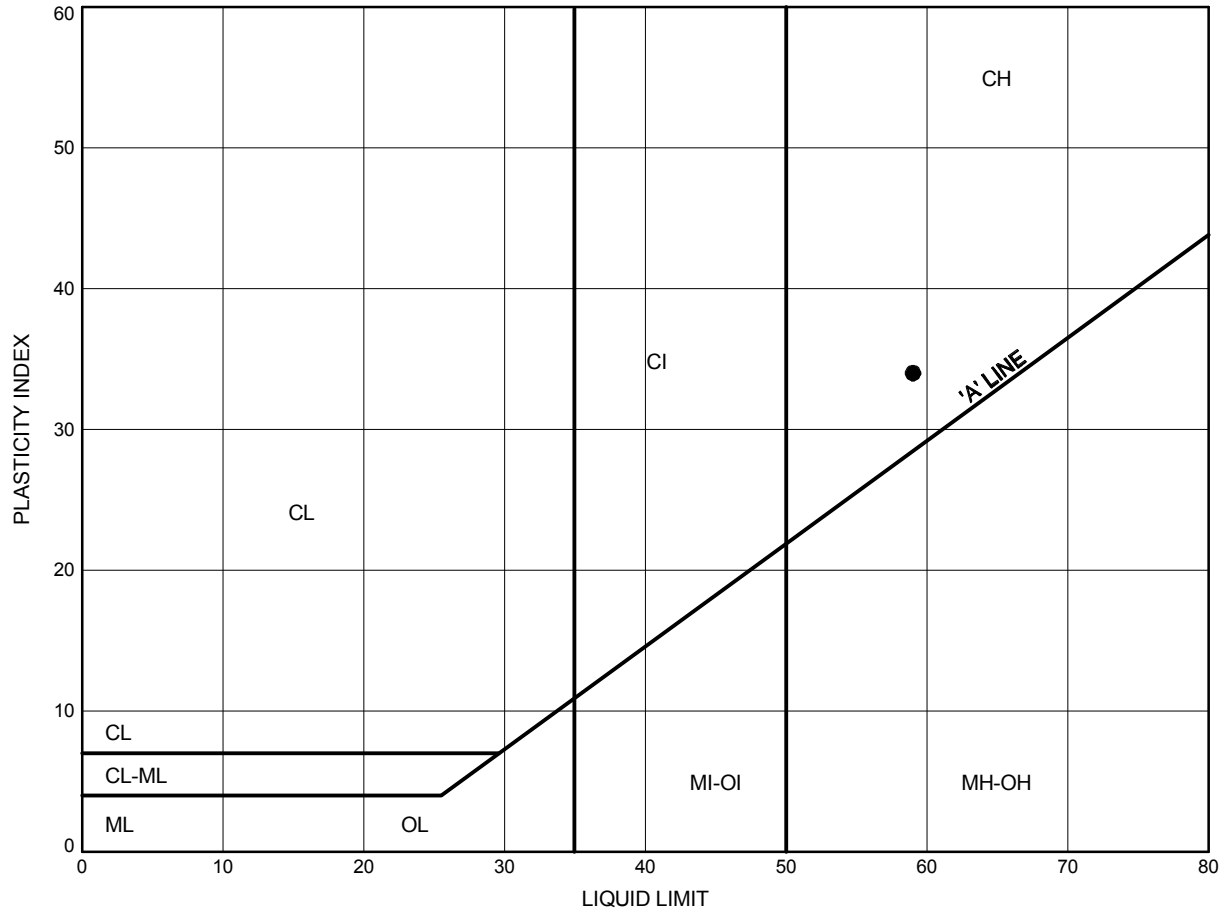
GRAIN SIZE DISTRIBUTION - THURBER 18006_HWY417SIGNS - NICHOLAS.GPJ 8/1/18

Nicholas Overhead Signs

ATTERBERG LIMITS TEST RESULTS

FIGURE C3

FILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-01	4.11	61.98

Date January 2018

GWP# 4048-11-00

THURBER

Prep'd DJP

Chkd. SD

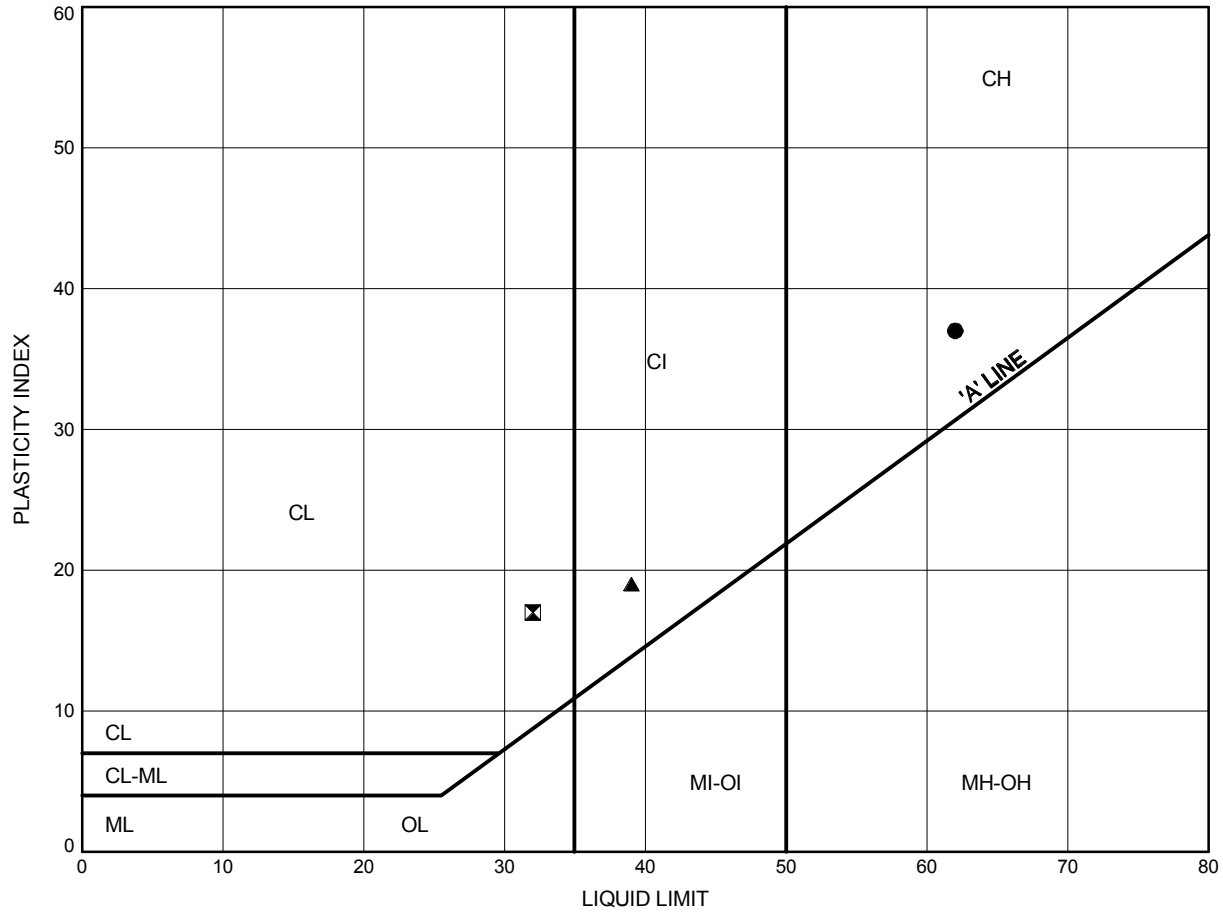
THURBALT 18006_HWY417SIGNS - NICHOLAS.GPJ 8/1/18

Nicholas Overhead Signs

ATTERBERG LIMITS TEST RESULTS

FIGURE C4

CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-01	7.92	58.17
⊠	17-02	9.45	57.65
▲	17-02	10.21	56.89

Date January 2018

GWP# 4048-11-00

THURBER

Prep'd DJP

Chkd. SD

THURBALT 18006_HWY417SIGNS - NICHOLAS.GPJ 8/1/18

Certificate of Analysis
Client: Thurber Engineering Ltd.
Client PO: 18006

Report Date: 09-Nov-2017
Order Date: 3-Nov-2017
Project Description: Hwy 417 Signs- Nicholas St

	Client ID:	17-02 SS#3 (5-7')	-	-	-
	Sample Date:	27-Oct-17	-	-	-
	Sample ID:	1744507-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	93.9	-	-	-
General Inorganics					
Conductivity	5 uS/cm	2560	-	-	-
pH	0.05 pH Units	7.86	-	-	-
Resistivity	0.10 Ohm.m	3.90	-	-	-
Anions					
Chloride	5 ug/g dry	763	-	-	-
Sulphate	5 ug/g dry	1700	-	-	-

Appendix D.

Site Photographs

Photo 1. Drill rig set up on Borehole 17-01, looking south (2017-10-26).

Photo 2. Borehole 17-01 upon completion of vibrating wire installation (2017-10-26).

Photo 3. Drill rig set up on Borehole 17-02, looking south (2017-10-27).

Photo 4. Borehole 17-02 upon completion of backfilling (2017-10-27).

Appendix E.

Table E1 – Geotechnical Design Parameters

MTO Sign Support Manual Standard Drawings

List of Special Provisions, Suggested Text for NSSP

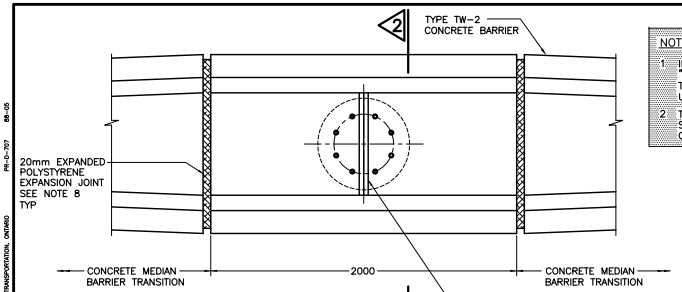
TABLE E1
GEOTECHNICAL DESIGN PARAMETERS
OVERHEAD SIGN REPLACEMENT
HIGHWAY 417 NICHOLAS STREET ON-RAMP

Footing	Borehole Details		Reference Simplified Subsurface Stratigraphy for Design	Depth Below Existing Grade (m)	Foundation Design Parameters					Groundwater Depth (m)
	Borehole	Depth (m)			C_u (kPa)	φ' (deg.)	γ (kN/m^3)	γ' (kN/m^3)	Kp	
Right	17-01	9.8	Fill: silty sand	0.0 - 1.9	-	30	20	10	3.0	
			Fill: clay	1.9 - 2.1	25	-	18			
			Fill: silty sand	2.1 - 2.9	-	30	20	10	3.0	2.6
			Fill: waste mixed with soil	2.9 - 4.6	-	28	15	5	2.8	
			Fill: sand	4.6 - 5.2	-	30	20	10	3.0	
			Clay, firm to very stiff	5.2 - 9.8	50	-	17			
Left	17-02	10.4	Fill: gravel, dense	0.0 - 1.2	-	32	22	12	3.3	
			Fill: sand to silty sand, trace waste	1.2 - 8.9	-	30	20	10	3.0	-
			Clay, firm to very stiff	8.9 - 10.4	50	-	17			

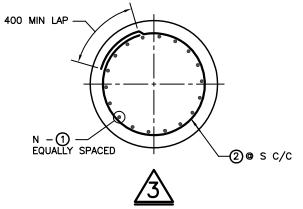
Definitions:

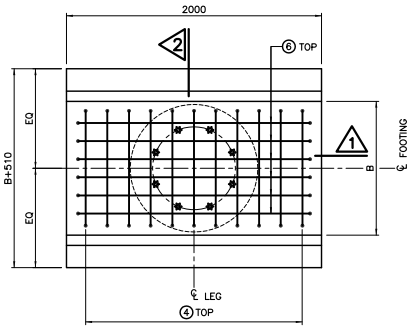
C_u = Undrained shear strength
φ' = Effective friction angle
γ = Total unit weight
γ' = Effective unit weight
Kp = Passive earth pressure coefficient

1. The information provided herein is presented for design purposes only.
2. The frost depth in Ottawa is 1.8 m.
3. Reference: MTO Sign Support Manual 2015



PLAN (*)





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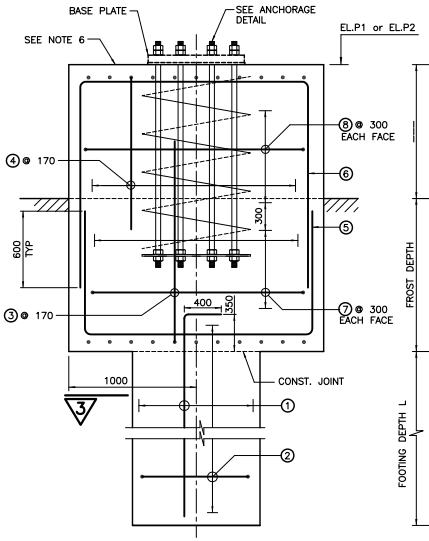
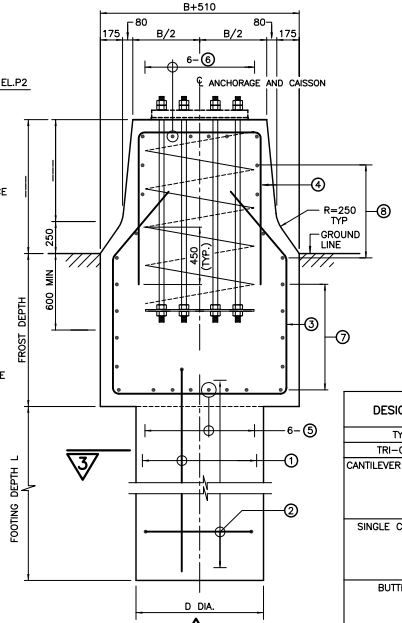
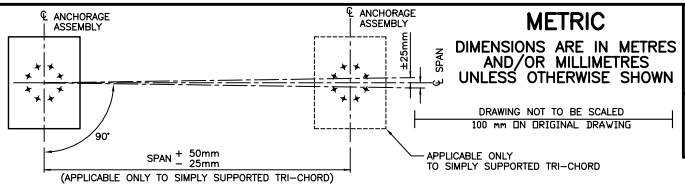


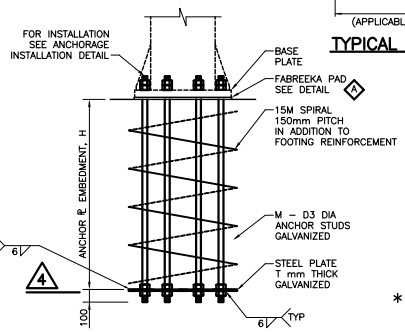
TYPICAL SECTION (*)



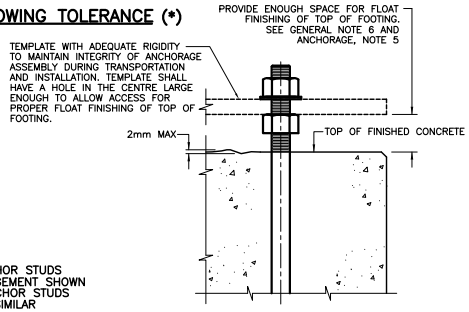
NOTES TO DESIGNER
1 IF SOUND ROCK IS ENCOUNTERED AT A DEPTH OF "Y" < L FROM THE BOTTOM OF THE FROST LAYER, THIS DIMENSION CAN BE REDUCED TO: Y + (L − Y)/2, UPON MINISTRY'S APPROVAL.
2 THE "DESIGN INFORMATION" TABLE AND "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



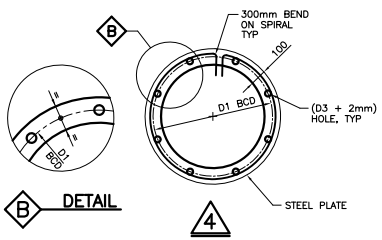
TYPICAL PLAN SHOWING TOLERANCE (*)



* NOTE: 8 ANCHOR STUDS ARRANGEMENT SHOWN 12 ANCHOR STUDS CASE SIMILAR

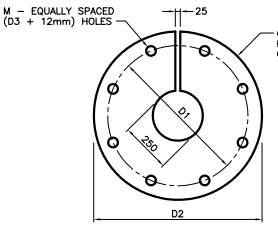


ANCHORAGE DETAIL (*)



B DETAIL

ANCHORAGE INSTALLATION DETAIL



A DETAIL

TABLE 1 - FOOTING DIMENSIONS

STATION	---									
STRUCTURE I.D. No.	---									
CLASS	---									
SPAN	---									
LEFT/RIGHT FOOTING	---									
EL.P1 or EL.P2	---									
FROST DEPTH	---									
L	---									
D	---									
N	---									
M	---									
D1	---									
D2	---									
D3	---									
T	---									
H	---									
S	---									
B	---									

DESIGN INFORMATION		FOOTING DEPTH L	FOOTING DIAMETER D	No. OF REBARS N	No. OF ANCHORS M	BOLT CIRCLE DIA D1	BASE ℄ DIAMETER D2	ANCHOR DIAMETER D3	ANCHOR ℄ THK. T	ANCHOR ℄ EMBED. H	RING SPACING S	B
TYPE	CLASS	(mm)	(mm)	(no.)	(no.)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
TRI-CHORD	–	5000	1000	18	8	750	900	38	12	1200	300	1050
CANTILEVER TRI-CHORD	1	6500	1350	22	12	850	1000	38	15	1200	300	1150
	2	6500	1350	22	12	850	1000	44	15	1500	300	1150
	3	7500	1350	22	12	900	1100	44	15	1500	275	1250
	4	7500	1500	22	12	950	1100	44	15	1500	225	1250
SINGLE CANTILEVER	1	5000	1000	18	8	750	900	38	12	1200	300	1050
	2	5000	1000	18	8	750	900	38	12	1200	300	1050
	3	6000	1200	18	8	750	900	38	12	1200	300	1050
	4	6500	1350	22	8	850	1000	44	15	1500	300	1150
BUTTERFLY	1	5500	1000	18	8	750	900	38	12	1200	300	1050
	2	5500	1000	18	8	750	900	38	12	1200	300	1050
	3	6700	1200	18	8	750	900	38	12	1200	300	1050
	4	7400	1350	22	8	850	1000	44	15	1500	300	1150
POLE MOUNTED VMS	–	4000	1000	15	8	600	750	32	10	1000	300	1050

GENERAL NOTES:

1. CLASS OF CONCRETE 30 MPa.
2. CLEAR COVER TO REINFORCING STEEL:
   –CAISSON 100±25mm
   –REMAINDER 80±20mm
3. REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
4. STRUCTURAL STEEL PLATE SHALL BE ACCORDING TO CAN/CSA-G40.20-13/G40.21-13, GRADE 300W.
5. EXCAVATION TO BE DONE NEAT AND CONCRETE PLACED AGAINST UNDISTURBED GROUND.
6. THE TOP OF FOOTINGS SHALL BE FLOAT FINISHED TO A TOLERANCE OF ± 0.1 DEGREES IN ANY DIRECTION AND WITHIN ± 10mm OF THE ELEVATION SHOWN. SURFACE ROUGHNESS SHALL NOT EXCEED 2mm AMPLITUDE.
7. GROUT BEDDING SHALL NOT BE USED.
8. EXPANDED POLYESTYRENE IN EXPANSION JOINT SHALL CONFORM TO CGSB 51.20 AND BE HELD IN PLACE WITH LIGHT GALVANIZED NAILS.
9. THIS DRAWING TO BE READ IN CONJUNCTION WITH GENERAL ARRANGEMENT DRAWING.
10. THE REINFORCING MAY BE ADJUSTED SLIGHTLY TO ACCOMMODATE THE ANCHOR STUDS.

ANCHORAGE NOTES:

1. STEEL ANCHOR STUDS, NUTS AND HARDENED STEEL WASHERS SHALL BE ACCORDING TO ASTM A449.
2. THE COMPLETE ANCHORAGE ASSEMBLY INCLUDING ANCHOR STUDS, NUTS AND WASHERS SHALL BE HOT DIP GALVANIZED.
3. ANCHORING NUTS SHALL BE BROUGHT TO A SNUG TIGHT CONDITION AND THEN FURTHER TIGHTENED 1/3 OF A TURN.
4. EXPOSED PORTION OF STUDS SHALL BE COATED WITH WHITE NON-STAINING GREASE.
5. ANCHORAGE SETTING TEMPLATE TO BE RIGID AND SECURELY HELD IN-PLACE TO MAINTAIN POSITION OF ANCHORAGE AND ALLOW FINISHING OF TOP OF FOOTING.

BAR MARK	SIZE	SHAPE
(1)	25M	400
(2)	15M	
(3)	20M	
(4)	20M	
(5)	20M	
(6)	20M	
(7)	20M	
(8)	20M	

REFER TO 2.4.1 IN THE SIGN SUPPORT MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS

OPSD 911.380 GUIDE RAIL SYSTEM, CONCRETE BARRIER PERMANENT TRANSITION INSTALLATION AT PIERS AND POLES

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

STATIC SIGN SUPPORT FOOTING DETAILS (MEDIAN MOUNTED – SYMMETRICAL)

STANDARD DRAWING JAN 2015

SS118-4

STATIC SIGN SUPPORT – FOOTING DETAILS (MEDIAN MOUNTED – SYMMETRICAL)

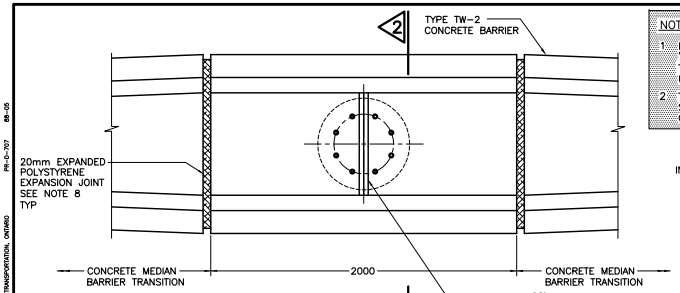
REVISIONS

DATE	BY	DESCRIPTION

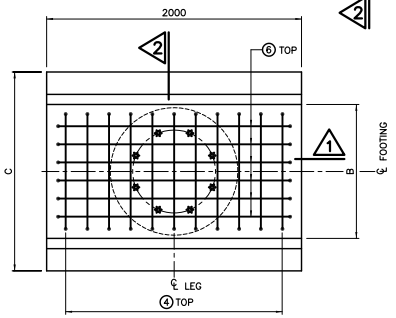
DESIGN	CHK	CODE CHBDC-06	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO
PR-0-707 88-05

DRAWING NAME: s118-4 Jan 15, 2015.dwg
CREATED: 1998/03/13
MODIFIED: 2015/01/23 12:07:05



PLAN (*)



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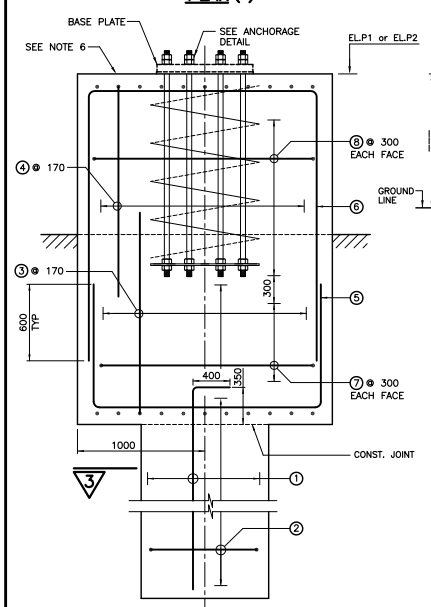
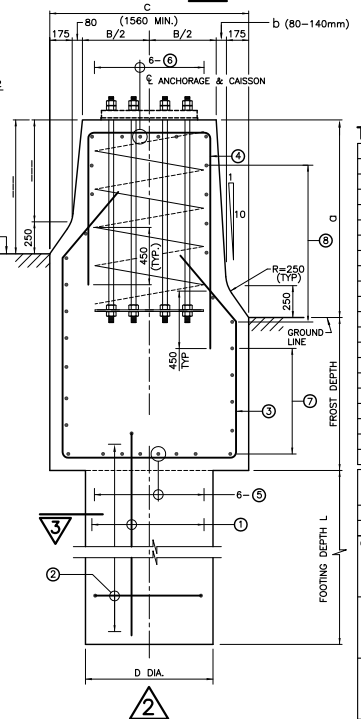




TYPICAL SECTION (*)

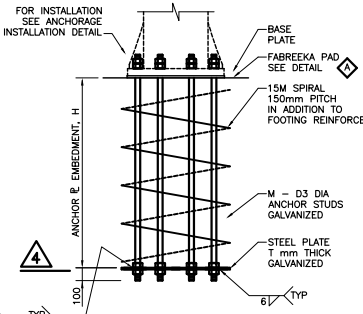
PLAN (*)

PLAN (*)

TYPICAL SECTION (*)

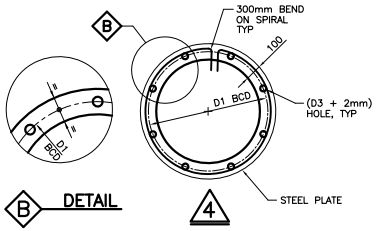
NOTES TO DESIGNER

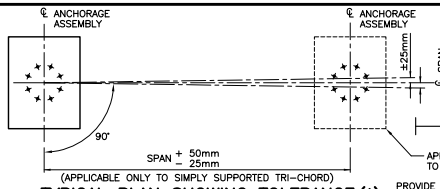
1. IF SOUND ROCK IS ENCOUNTERED AT A DEPTH OF "Y" < L FROM THE BOTTOM OF THE FROST LAYER, THIS DIMENSION CAN BE REDUCED TO: Y + (L − Y)/2, UPON MINISTRY'S APPROVAL.
2. THE "DESIGN INFORMATION" TABLE AND "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



ANCHORAGE DETAIL (*)

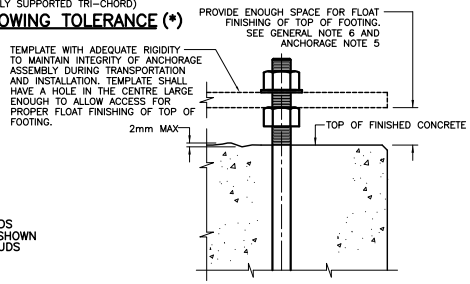
* NOTE: 8 ANCHOR STUDS ARRANGEMENT SHOWN 12 ANCHOR STUDS CASE SIMILAR





TYPICAL PLAN SHOWING TOLERANCE (*)

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING



ANCHORAGE INSTALLATION DETAIL

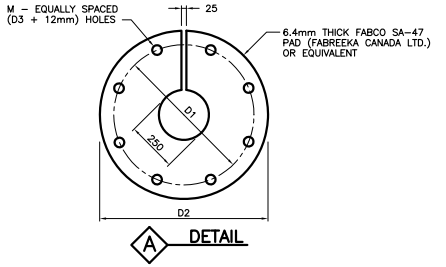


TABLE 1 – FOOTING DIMENSIONS

STATION	---									
STRUCTURE I.D. No.	---									
CLASS	---									
SPAN	---									
LEFT/RIGHT FOOTING	---									
a										
b										
c										
EL.P1 or EL.P2	---									
FROST DEPTH	---									
L	---									
D	---									
N	---									
M	---									
D1	---									
D2	---									
D3	---									
T	---									
H	---									
S	---									
B	---									

DESIGN INFORMATION		FOOTING DEPTH L	FOOTING DIAMETER D	No. OF REBARS N	No. OF ANCHORS M	BOLT CIRCLE DIA D1	BASE ℄ DIAMETER D2	ANCHOR DIAMETER D3	ANCHOR ℄ THK. T	ANCHOR ℄ EMBED. H	RING SPACING S	B
TYPE	CLASS	(mm)	(mm)	(no.)	(no.)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
TRI-CHORD	–	5000	1000	18	8	750	900	38	12	1200	300	1050
CANTILEVER TRI-CHORD	1	6500	1350	22	12	850	1000	38	15	1200	300	1150
	2	6500	1350	22	12	850	1000	44	15	1500	300	1150
	3	7500	1350	22	12	900	1100	44	15	1500	275	1250
	4	7500	1500	22	12	950	1100	44	15	1500	225	1250
SINGLE CANTILEVER	1	5000	1000	18	8	750	900	38	12	1200	300	1050
	2	5000	1000	18	8	750	900	38	12	1200	300	1050
	3	6000	1200	18	8	750	900	38	12	1200	300	1050
	4	6500	1350	22	8	850	1000	44	15	1500	300	1150
BUTTERFLY	1	5500	1000	18	8	750	900	38	12	1200	300	1050
	2	5500	1000	18	8	750	900	38	12	1200	300	1050
	3	6700	1200	18	8	750	900	38	12	1200	300	1050
	4	7400	1350	22	8	850	1000	44	15	1500	300	1150
POLE MOUNTED VMS	–	4000	1000	15	8	600	750	32	10	1000	300	1050

GENERAL NOTES:

1. CLASS OF CONCRETE 30 MPa.
2. CLEAR COVER TO REINFORCING STEEL:
   –CAISSON 100±25mm
   –REMAINDER 80±20mm
3. REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
4. STRUCTURAL STEEL PLATE SHALL BE ACCORDING TO CAN/CSA–G40.20–13/G40.21–13, GRADE 300W.
5. EXCAVATION TO BE DONE NEAT AND CONCRETE PLACED AGAINST UNDISTURBED GROUND.
6. THE TOP OF FOOTINGS SHALL BE FLOAT FINISHED TO A TOLERANCE OF ±0.1 DEGREES IN ANY DIRECTION AND WITHIN ±10mm OF THE ELEVATION SHOWN. SURFACE ROUGHNESS SHALL NOT EXCEED 2mm AMPLITUDE.
7. GROUT BEDDING SHALL NOT BE USED.
8. EXPANDED POLYESTYRENE IN EXPANSION JOINT SHALL CONFORM TO CGSB 51.20 AND BE HELD IN PLACE WITH LIGHT GALVANIZED NAILS.
9. THIS DRAWING TO BE READ IN CONJUNCTION WITH GENERAL ARRANGEMENT DRAWING.
10. THE REINFORCING MAY BE ADJUSTED SLIGHTLY TO ACCOMMODATE THE ANCHOR STUDS.

ANCHORAGE NOTES:

1. STEEL ANCHOR STUDS, NUTS AND HARDENED STEEL WASHERS SHALL BE ACCORDING TO ASTM A449.
2. THE COMPLETE ANCHORAGE ASSEMBLY INCLUDING ANCHOR STUDS, NUTS AND WASHERS SHALL BE HOT DIP GALVANIZED.
3. ANCHORING NUTS SHALL BE BROUGHT TO A SNUG TIGHT CONDITION AND THEN FURTHER TIGHTENED 1/3 OF A TURN.
4. EXPOSED PORTION OF STUDS SHALL BE COATED WITH WHITE NON–STAINING GREASE.
5. ANCHORAGE SETTING TEMPLATE TO BE RIGID AND SECURELY HELD IN–PLACE TO MAINTAIN POSITION OF ANCHORAGE AND ALLOW FINISHING OF TOP OF FOOTING.

BAR MARK	SIZE	SHAPE
①	25M	400
②	15M	
③	20M	
④	20M	
⑤	20M	
⑥	20M	
⑦	20M	
⑧	20M	

REFER TO 2.4.1 IN THE SIGN SUPPORT MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS

OPSD 911.380 GUIDE RAIL SYSTEM, CONCRETE BARRIER PERMANENT TRANSITION INSTALLATION AT PIERS AND POLES

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

STATIC SIGN SUPPORT FOOTING DETAILS (MEDIAN MOUNTED – ASYMMETRICAL)

STANDARD DRAWING JAN 2015

SS118–5

STATIC SIGN SUPPORT – FOOTING DETAILS (MEDIAN MOUNTED – ASYMMETRICAL)

REVISIONS			
	DATE	BY	DESCRIPTION

DESIGN	CHK	CODE CHBDC–06	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO
FR-0-707 88-05

DRAWING NAME: s118-5 Jan 15, 2015.dwg
CREATED: 1998/03/13
MODIFIED: 2015/01/23 12:13:32

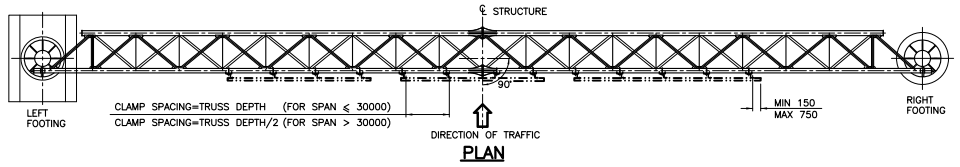
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

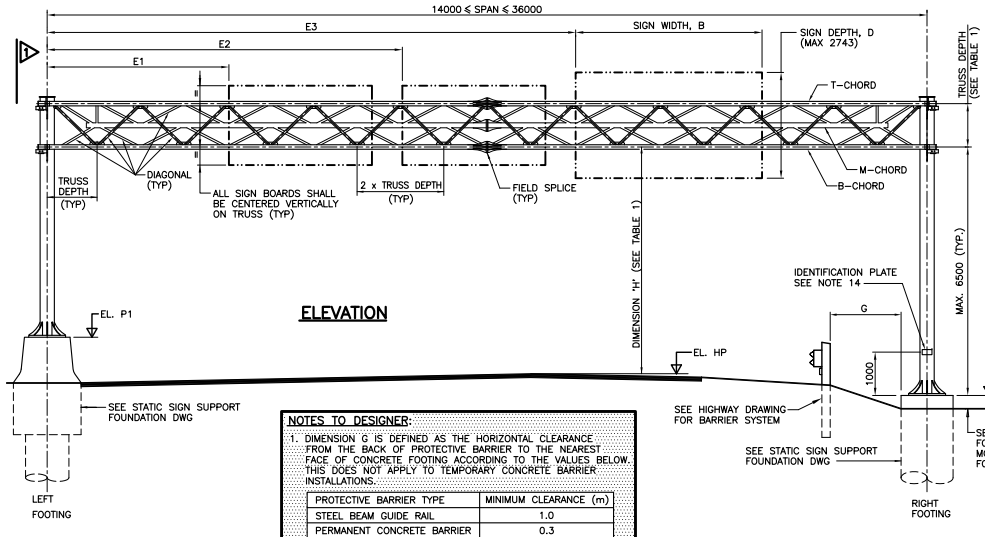
CONT No
WP No

SHEET

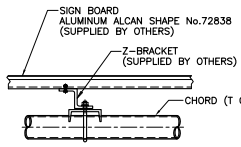
TRI–CHORD STATIC SIGN SUPPORT GENERAL ARRANGEMENT



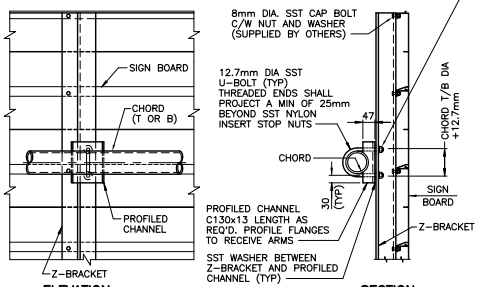
PLAN



ELEVATION



PLAN



ELEVATION SECTION

SIGN CONNECTION DETAIL

NOTES:

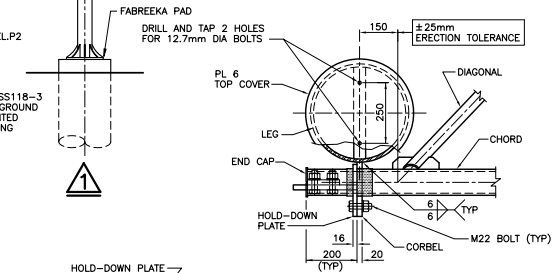
1. ALL SECTIONS SHALL BE STRUCTURAL STEEL UNLESS NOTED.
2. ALL STRUCTURAL STEEL SHALL BE ACCORDING TO CAN/CSA G40.20–04/G40.21–04 GRADE 300W OR ASTM SPECIFICATION A500 GRADE C, STRUCTURAL TUBING.
3. WALL THICKNESS OF MEMBERS:
   - CHORDS 6.4mm
   - DIAGONALS 3.2mm
   - LEGS 12.7mm
4. TOTAL SIGN BOARD AREA ON STRUCTURE SHALL NOT EXCEED 45m^2, BASED ON A REFERENCE WIND PRESSURE OF 600Pa.
5. ALL NON–STAINLESS STEEL BOLTS, NUTS, AND WASHERS SHALL BE ACCORDING TO ASTM A325M AND BE HOT–DIP GALVANIZED UNLESS NOTED.
6. ALL STAINLESS STEEL BOLTS, NUTS, AND WASHERS SHALL BE ACCORDING TO ASTM F593 ALLOY 304 WITH A MINIMUM YIELD OF 480 MPa AND A MINIMUM TENSILE STRENGTH OF 715 MPa.
7. ALL BOLTS SHALL BE INSTALLED BY TURN OF NUT TIGHTENING IN CONFORMANCE WITH CAN/CSA S6–06.
8. ALL STRUCTURAL STEEL SHALL BE HOT–DIP GALVANIZED AFTER FABRICATION. LEGS ONLY SHALL BE SUBSEQUENTLY COATED WITH AN APPROVED PAINT SYSTEM ACCORDING TO OPSS 911.
9. STRUCTURE SHALL NOT BE ERECTED UNTIL FOUNDATION CONCRETE HAS REACHED 80% OF SPECIFIED STRENGTH.
10. NO SHOP SPLICES IN ANY MEMBER. TRUSS FIELD SPLICES SHALL BE KEPT TO A MAXIMUM OF 2.
11. CLAMPS SHALL BE POSITIONED NEXT TO NODES.
12. SPAN LENGTHS AND ELEVATIONS TO BE VERIFIED IN THE FIELD BEFORE SIGN SUPPORT STRUCTURE FABRICATION.
13. THIS STANDARD TO BE READ IN CONJUNCTION WITH SS118–27 (STRUCTURE ASSEMBLY DETAILS), SS118–3 (GROUND MOUNTED FOOTING), AND/OR SS118–4 (MEDIAN MOUNTED FOOTING – SYMM.), AND/OR SS118–5 (MEDIAN MOUNTED FOOTING – ASYMM.).
14. EACH SIGN SUPPORT SHALL HAVE AN IDENTIFICATION MARKING SHOWING THE STRUCTURE I.D. NUMBER, THE SIGN AREA AND THE LOCAL REFERENCE WIND PRESSURE AS SHOWN IN TABLE 1, THE MANUFACTURER'S NAME OR TRADEMARK, AND THE DATE OF MANUFACTURE. THIS 4mm THICK RECTANGULAR STAINLESS STEEL PLATE SHALL HAVE A RUBBER BACKING, AND BE OF SUFFICIENT DIMENSIONS TO ACCOMMODATE THE REQUIRED INFORMATION USING 6mm HIGH ENGRAVED LETTERING. THE PLATE SHALL BE ATTACHED TO THE LEG OF THE STRUCTURE BY MEANS OF STAINLESS STEEL BAND CLAMPS THAT GO THROUGH VERTICAL HOLES AT EACH SIDE OF THE PLATE, PASS BEHIND THE PLATE, AND WRAP AROUND THE LEG. NO DRILLING INTO THE HSS FOR ATTACHMENT OF PLATE IS PERMITTED.
15. LEGEND:
    SST – DENOTES STAINLESS STEEL
    O.D. – DENOTES OUTSIDE DIAMETER

NOTES TO DESIGNER:

1. DIMENSION G IS DEFINED AS THE HORIZONTAL CLEARANCE FROM THE BACK OF PROTECTIVE BARRIER TO THE NEAREST FACE OF CONCRETE FOOTING ACCORDING TO THE VALUES BELOW. THIS DOES NOT APPLY TO TEMPORARY CONCRETE BARRIER INSTALLATIONS.

PROTECTIVE BARRIER TYPE	MINIMUM CLEARANCE (m)
STEEL BEAM GUIDE RAIL	1.0
PERMANENT CONCRETE BARRIER	0.3

2. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



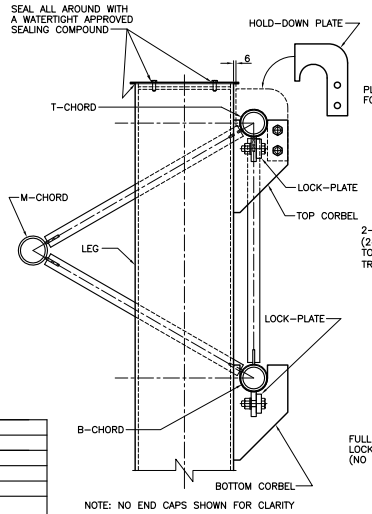
PLAN

TABLE 1 – GENERAL

STATION		---									
STRUCTURE I.D. No.		---									
SPAN		---									
TRUSS DEPTH (C/C OF CHORDS)		---									
DIMENSION 'H'		---									
LOCAL REFERENCE WIND PRESSURE, Pa		---									
MAXIMUM ALLOWABLE SIGN BOARD AREA, m2		---									
1 SIGN SIZE (DxB)		---									
2 SIGN SIZE (DxB)		---									
3 SIGN SIZE (DxB)		---									
E1		---									
E2		---									
E3		---									
G		---									
EL.HP		---									
EL.P1		---									
EL.P2		---									
SUPPORT LEG	O.D.	---									
CHORDS	T/B O.D.	---									
	M O.D.	---									
DIAGONALS	O.D.	---									
FOOTING TYPE (LEFT)		---									
FOOTING TYPE (RIGHT)		---									

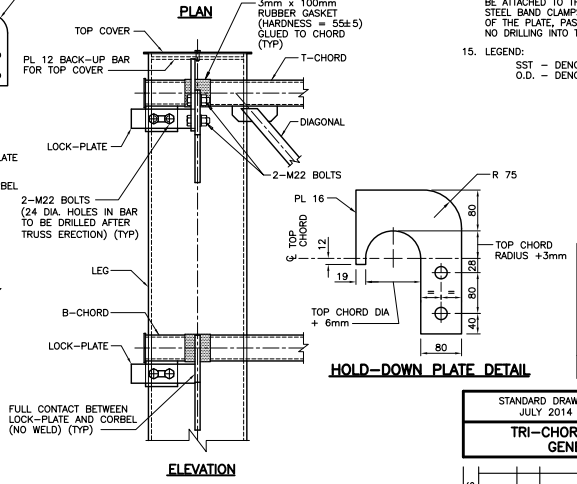
TABLE 2 – SIGN BOARD: PARTS/HARDWARE

STATION	---										
DESCRIPTION	QUANT.										
12.7mm DIA. SST U–BOLT	---										
SST NYLON INSERT STOP NUTS	---										
SST WASHERS	---										
PROFILED CHANNEL (C130x13. LENGTH AS REQ'D PROFILE FLANGES TO RECEIVE ARMS).	---										
Z–BRACKET (SUPPLIED BY OTHERS)	---										
Z–BRACKET SPACING	---										



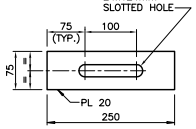
NOTE: NO END CAPS SHOWN FOR CLARITY

SIDE VIEW



ELEVATION

HOLD–DOWN PLATE DETAIL



LOCK–PLATE DETAIL

REFER TO 2.4.1 IN THE SIGN SUPPORT MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

A TRUSS TO LEG CONNECTION TYPICAL DETAIL

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

STANDARD DRAWING JULY 2014 | SS118–26

TRI–CHORD STATIC SIGN SUPPORT GENERAL ARRANGEMENT

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN STD	CHK	CODE OHBDC '91	LOAD / DATE
DRAWN	CHK	SITE	DWG

DRAWING NAME: s118–26 July 2104.dwg
CREATED: 1998/03/13
MODIFIED: 2014/07/16 16:49:14

MINISTRY OF TRANSPORTATION, ONTARIO
PR–D–707 88–05

1. The following Special Provisions and OPSS Documents are referenced in this report:

OPSS 903	Construction Specification for Deep Foundations
OPSS 915	Construction Specification for Sign Support Structures
OPSD 3090.101	Foundation Frost Penetration Depths for Southern Ontario

2. Suggested text for a NSSP on **"**Caisson Construction for Overhead Sign Foundations"

The Contractor is advised that variable types of subsurface materials may be encountered at the overhead sign foundation locations. For additional information regarding soil conditions, the Contractor is referred to the Foundation Investigation Report.

For bidding purposes, the Contractor shall assume the following:

1. The subsurface conditions at a foundation location are the same as those encountered in the borehole closest to the subject foundation location.

2. There is a probability that occasional cobbles and boulders or other obstructions may be encountered within the fill. Caisson installation equipment must be able to penetrate or remove these obstructions.

3. Water seepage and/or soil sloughing into the caisson hole may occur from existing fill and cohesionless soils at some locations. Temporary liners must be available on site, or be made available on very short notice, to support the caisson sidewalls and provide seepage cut-off where required.

4. The Contractor is responsible for constructing the sign foundations without disturbing the material at the sides or bases of the foundations.

5. The contractor is responsible for proper disposal of materials generated from the site.